PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : F01N 3/10, 3/26	A1	(11) International Publication Number: WO 92/14042 (43) International Publication Date: 20 August 1992 (20.08.92)

(21) International Application Number: PCT/EP92/00194

(22) International Filing Date: 30 January 1992 (30.01.92)

(30) Priority data:
CZ91A000001 8 February 1991 (08.02.91) IT

(71) Applicant *(for all designated States except US)*: SOLECO S.R.L. SOLUZIONI ECOLOGICHE [IT/IT]; Via Nazionale ang. Via Matera, I-88075 Cutro (IT).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : PERTICONE, Elio [IT/IT]; Via Nazionale ang. Via Matera, I-88075 Cutro (IT).

(74) Agent: LOTTI, Giorgio; Ing. Barzanò & Zanardo Milano S.p.A., Via Cernaia 20, I-10122 Torino (IT).

(81) Designated States: AT (European patent), AU, BE (European patent), BR, CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), NO, RU, SE (European patent), US.

Published
With international search report.

(54) Title: THERMAL DESTRUCTION PROCESS FOR ELIMINATING POLLUTANTS FROM DIESEL ENGINE EMISSIONS

(57) Abstract

A process for eliminating the organic fumes and chemical pollutants from emissions from diesel engines before their emission into the atmosphere provides for the exhaust gases leaving the manifold of the combustion chamber of diesel engines to pass through flow-breaking barriers which are suitably formed and arranged within a highly insulating container. The whole will be made from special inoxidable alloys, and special thermally-insulating and refractory materials. When traversed by the flow of hot exhaust gases, the flow-breaking barriers reach temperatures which are high enough to burn the unburnt hydrocarbons, the organic particles and such as to activate oxide-reducing processes suitable for converting the major proportion of the chemical pollutants.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FI	Finland	ML	Mali
AU	Australia	FR	France	MN	Mongolia
BB	Barbados	GA	Gabon	MR	Mauritania
BE	Belgium	GB	United Kingdom	MW	Malawi
BF	Burkina Faso	GN	Guinea	NL	Netherlands
BG	Bulgaria	GR	Greece	NO	Norway
BJ	Benin	HU	Hungary	PL	Poland
BR	Brazil	IE	Ireland	RO	Romania
CA	Canada	IT	Italy	RU	Russian Federation
CF	Central African Republic	JP	Japan	SD	Sudan
CG	Congo	KP	Democratic People's Republic of Korea	SE	Sweden
CH	Switzerland			SN	Senegal
CI	Côte d'Ivoire	KR	Republic of Korea	SU	Soviet Union
CM	Cameroon	LI	Liechtenstein	TD	Chad
CS	Czechoslovakia	LK	Sri Lanka	TG	Togo
DE	Germany	LU	Luxembourg	US	United States of America
DK	Denmark	MC	Monaco		
ES	Spain	MG	Madagascar		

THERMAL DESTRUCTION PROCESS FOR ELIMINATING POLLUTANTS FROM DIESEL ENGINE EMISSIONS

DESCRIPTION

The invention relates to a chemico-physical process of thermal-destruction and pyrolysis which is able to achieve a drastic, and almost total, reduction in the chemical pollutant content of emissions from diesel engines before these are emitted into the atmosphere, the pollutants including unburnt hydrocarbons, organic particles, aldehydes, phenols, mercaptans, aromatic and volatile substances. Oxide-reduction processes suitable for converting almost all the oxyacids are also triggered. Substances which cause bad smells and irritation to the mucous membranes, eyes, nose, pharynx, larynx and bronchi and whose trans-mucous or trans-cutaneous absorbtion may cause cancer in the long term are also eliminated.

It is perhaps superfluous to talk of the harm caused by emissions into the atmosphere from means of transport since these represent one of the major sources of atmospheric pollution universally recognised today.

Acid rain, defoliation, the greenhouse effect, the crumbling of monuments and buildings, the carcinogenic

effect, irritations of the respiratory tract, bronchitis, asthma, emphysema, irritations of the skin and congunctive membranes, corrosion of textile fibres and sheet metals are only the most apparent of the harmful phenomena caused by the particles, oxyacids (CO, CO_2, NO_x, SO_x) etc, etc.

Devices currently already exist for breaking down the pollutants formed in internal combustion engines before these are discharged into the atmosphere.

Three-way catalytic converters in particular reduce the levels of carbon monoxide, oxides of nitrogen and unburnt hydrocarbons but they are not able to eliminate carbonaceous substances from the particle content since combustion of the latter would raise the temperature of the catalyst dangerously, rendering it unserviceable and, in any case, are unsuitable for diesel engines.

Ceramic filter traps for the particles are devices of a dynamic type which are thus susceptible to breakdown such as: fracture of the ceramic filter, clogging of the filter plugs and of the porous beds, malfunction of the solenoid valves or of the injectors for the regeneration. Moreover, for the regeneration to be carried out, they require either the stoppage of the motor vehicle or a dual system and they require a further energy input to reach the combustion temperature, they become clogged

after every two hundred kilometres of travel, they require considerable expenditure in management and maintenance, they eliminate only about 80% of the particle content and are very expensive.

Finally it is appropriate to make a joint comment on catalytic silencers and particle traps. In both devices, because of the heat of the exhaust flow, erosion of the catalytic beds or of the filter plugs occurs with the release of discrete quantities of powdered silicaceous ceramic material into the atmosphere in which the silicon is present in crystalline form, or the release of cordierite-type powders, cordierite being a magnesium aluminosilicate which is very similar to asbestos. These silicon compounds, if present in crystalline form, are dangerous to health if inhaled over long periods in that they may cause silicosis, pulmonary fibromatosis and tumours.

An object of the invention is to provide a thermo-destructive process which eliminates, almost completely and immediately, the fumes and hence the organic particles, including carbon black, unburnt hydrocarbons, products of cracking and polymerisation, lubricating oils and additives.

Another object of the inventive process is to achieve an energy saving in that the high temperatures needed to

trigger the thermo-destructive process are obtained without the need to add external energy but by the recovery of almost all the thermal energy contained in the flow of exhaust gases.

Another object of the inventive process is to enable the realisation of devices for countering chemical pollutants for installation in diesel engines, both in terrestrial and marine vehicles and in fixed installations before the emissions are passed into the atmosphere.

A further object of the process in question is to break down the carbon monoxide, nitrogen dioxide and sulphur dioxide by virtue of the fact that a highly oxide-reductive ambient is created in the thermo-destructive chamber which is in fact a pyrolytic reactor.

Another object is to reduce noise and hence combat noise pollution in that materials are used both in the flow-breaking barriers and for the thermal insulators which are capable of absorbing, reflecting and refracting sound waves.

A further object is to enable the production of anti-polluting devices which do not in their turn produce secondary pollution by the release of powdered materials from erosion, such as crystalline silicon, catalysts and aluminium-magnesium silicates of the cordieritic type and

which thus contribute to the ecology and are themselves ecological even when they are in turn dismantled, the materials used being wholly recycled.

Another object is to enable the provision of devices which are not only efficient but also technically simple to make and install and, above all, economic.

To achieve these and other objects which will become clearer from the description which follows, the invention proposes a purification process adapted to provide anti-polluting devices which, by means of the heat recovered from the emissions themselves, and with a post-combustion, pyrolytic and oxide-reductive thermal process, can destroy the combustion metabolites, with the exception of carbon dioxide, in emissions from diesel engines. The process is characterised in that, before the emissions are passed into the atmosphere, they are passed into a refractory chamber which is also highly thermally insulating, in that the emissions are made to pass through and flow over flow-breaking barriers which are highly resistant to erosion and completely free from ceramic material containing silicon in crystalline form. As a result of the high temperatures occurring at the beginning of the pyrolytic and oxide-reductive thermal process, the kinetic and thermal energy in the emissions themselves is recovered without the need for the further addition of external energy or the presence of catalysts.

A preferred, non-limiting embodiment of the process of the invention will now be described, numerous variants being possible to accord with different industrial and environmental requirements in order to enable it to be applied to the realisation of devices for countering atmospheric pollution.

The thermo-destructive purification process is achieved by passing the exhaust emissions through flow-breaking barriers. According to the technical requirements, the emissions may pass through the barriers either axially or radially and hence the barriers will be formed appropriately to allow these two forms of passage.

The flow-breaking barriers will be made from refractory material of inoxidable alloys and ceramified , sintered and electrofused refractory oxides which can withstand chemical attack in high-temperature environments with high flow velocities.

The flow-breaking barriers should offer very large contact surfaces and hence the refractory materials used, as far as other technical requirements and counter-pressures allow, may be of grid/cellular, laminar, spiral, granular and spherical form, 50% having a high density and the remaining 50% having a porosity of no more than 54% closed pores/open pores.

The barriers should have a very high thermal capacity together with a high thermal conductivity and, to achieve this, in one of the various possible uses of the materials, there is a preference for the use of stainless steel alloys and refractory oxides of iron, copper, magnesium and aluminium. According to the various methods of preparation, these oxides may be obtained by: electrofusion, calcining, sintering and ceramification.

The flow-breaking barriers are formed within a refractory chamber which is also highly thermally insulating. This chamber, which functions as a pyrolytic and thermal reactor, will be located as close as possible to the points at which the emissions have their highest temperature, with the adoption of all those devices and technologies which are most able to limit, as far as possible, the heat loss and dissipation during the collection of the emissions to be purified.

According to requirements, the chambers and their flow-breaking barriers may be made in any shape and capacity while respecting the following technical characteristics:

A) The thermodestruction chamber should have walls of refractory material which can withstand the thermal and chemical attack, the capacity of the chamber should accord with the installation for which it is destined, as

well as the velocity and volume of gases which are to pass through it per unit time without this creating counterpressures up stream.

B) The flow-breaking barriers will be housed in the thermodestruction chamber and will be volumetrically proportional thereto, occupying the entirety of it if the emissions are to be passed through axially. Along the major axis and leaving a space entirely around it if the passage of the flow is to be of centripetal and centrifugal radial type.

C) The flow-breaking barriers may be fixed rigidly to the chamber itself or may be in the form of interchangeable cartridges and in this case will be inserted in the chamber and fixed by suitable flanging. The refractory oxides of which the barriers are formed should have a high thermal capacity together with a high thermal conductivity.

D) The thermodestruction chamber, as well as being made from refractory steels, should have a double jacket with a highly insulating material in the interspace thereof so as to limit the heat dispersion as far as possible to assist the operation of the process.

The basic principle of the process for the thermal destruction of pollutants in the combustion emissions

from diesel engines, although being simple, is original and innovative.

The flow of hot fumes passing through the metal grid gives up heat by radiation and raises the temperature of the grid/cellular, ball and granular, refractory oxide material to values such as to trigger the thermal destruction, pyrolysis and oxide-reduction processes. At the inlet to the chamber the fumes should have a temperature of at least 500 degrees Celsius.

CLAIMS

1. A process for the thermal destruction of pollutants in emissions from combustion processes in diesel engines and industrial processes, characterised in that, before being discharged from the exhaust into the atmosphere, the emissions pass through flow-breaking barriers on which the fumes, particles and gas impinge to be subjected to degradation by thermal-destruction, pyrolysis and oxide-reduction.

2. A process according to Claim 1, characterised in that the high temperatures are reached by means of the heat from endothermic combustion process itself, without the addition of further energy.

3. A process according to Claim 1, characterised in that the flow-breaking barriers are made from inoxidable refractory alloys in the form of porous or cellular-grids and from magnesium, copper, iron and aluminium oxide refractory materials in the form of granules or spheres.

4. A process according to Claim 1, characterised in that the flow-breaking barriers are of high-density refractory material with a high thermal conductivity and thermal capacity and are not of monolithic type but are of porous, grid/cellular, spiral, laminar, granular and spherical form.

5. A process according to Claim 1, characterised in that the flow-breaking barriers are changeable.

6. A process according to Claim 1, characterised in that the flow-breaking barriers are provided in a container having an inlet and an exit for the emissions, and which can withstand high temperatures and is made from special inoxidable alloys.

7. A process according to Claim 1, characterised in that the container for the flow-breaking barriers is insulated thermally by means of a double jacket containing insulating material so as not to disperse the heat for triggering the thermodestruction, pyrolysis and oxide-reduction processes.

8. A process according to Claim 1, characterised in that the thermodestruction chamber containing the flow-breaking barriers is placed close to the exhaust manifold.

9. A process according to Claim 1, characterised in that both the exhaust manifold and the pipe for conducting the emissions to the thermodestruction chamber are of insulating material so as to limit the dispersion of the heat needed for the process.

10. A process according to Claim 1, characterised in

that the flow-breaking barriers and the materials used are not prone to clogging and, by virtue of the temperatures reached, are self-regenerating.

INTERNATIONAL SEARCH REPORT

International Application No PCT/EP 92/00194

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 F01N3/10; F01N3/26

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	F01N ; B01D

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
Y	US,A,4 125 380 (NEGOLA) 14 November 1978 see column 1, line 56 - column 2, line 34; claims 1-9; figures 2-6 ---	1-10
Y	WO,A,9 015 228 (SIBBERTSEN ET AL.) 13 December 1990 see page 2, line 21 - line 28; figures 1,2 ---	1-8,10
Y	DE,A,2 452 556 (AUDI NSU AUTO UNION AG) 13 May 1976 see page 2, line 1 - line 13 ---	9
A	DE,A,3 501 923 (GLOTUR TRUST) 24 July 1986 see page 6, line 4 - line 10; claims 1-10; figure 1 ---	1-3,6-10
A	AU,D,4 041 572 (CORBETT) 25 October 1973 see the whole document ---	1,3,4

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
01 APRIL 1992	15.04.92
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	A.F. ~~EIJKENBOOM~~

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. EP 9200194 SA 55632

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 01/04/92
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4125380	14-11-78	None		
WO-A-9015228	13-12-90	DE-A-	3917888	06-12-90
		CA-A-	2033345	02-12-90
		EP-A-	0431105	12-06-91
DE-A-2452556	13-05-76	None		
DE-A-3501923	24-07-86	None		
AU-D-4041572	25-10-73	None		

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82